cephalic and more variable than the men. This is in accordance with the general conclusion reached in a paper on "Variation in Man and Woman,"* namely:

"The lower races give us results in sensible accordance with those we have drawn from the data for ancient civilisations, namely, the women are on the whole more brachycephalic and slightly more variable than the men."

(*e*) The younger generation is more brachycephalic and more variable than its parentage.

The whole of this difference can hardly be due to any change of shape of the skull with old age, for the majority of parents had in this case not passed the prime of life. It may be due to (i) a correlation between dolichocephaly and fertility or between dolichocephaly and philogamy, or (ii) more probably to the action of natural selection (results obtained, but not yet published, by the present writers show a correlation between physique and cephalic index), or (iii) to a greater or less admixture of white blood in the younger generation.

(*f*) Parents of sons are significantly less variable than parents of daughters. This is in accordance with the result previously obtained that mediocre fathers are likely to have sons,† but disagrees with the result for stature—based on a far smaller probability—that mediocre mothers are likely to have daughters.

The conclusions of this paper, while appearing to the writers of interest, are to be taken, in the first place, as *suggestions* for much larger series of measurements and for new lines of investigation.

"Comparison of Oxygen with the Extra Lines in the Spectra of the Helium Stars, β Crucis, &c.; also Summary of the Spectra of Southern Stars to the $3\frac{1}{2}$ Magnitude and their Distribution." By Frank McClean, F.R.S. Received January 12,—Read February 3, 1898.

[Plate 6.]

In a previous paper read before the Society on April 8, 1897, I suggested that the special lines present in spectra of the first division of helium stars (Type I, Divison 1*a*) might possibly be due to oxygen. These stars are associated by their position and distribution with the gaseous nebulæ, and some of the lines in their spectra correspond with bright lines observed by Campbell in nebulæ. The suggestion from this was that these stars are in the first stage of stellar development from gaseous nebulæ.

* Pearson, 'The Chances of Death,' vol. 1, p. 370.

† 'Phil. Trans.,' A, vol. 187, p. 274.

The special lines referred to are the extra lines which distinguish these spectra from those of the remaining helium stars of Division I*b*.

The indications in the spectra of the northern stars that these extra lines are due to oxygen are slight, as the lines at best are indistinct. Among the southern stars, however, there are several in the spectra of which these lines are better defined, and there is one, viz., β Crucis, in which they are very fairly defined.

The following stellar spectra are mounted on the accompanying plate, viz., κ Orionis, β Scorpii, β Canis Majoris, β Centauri, and β Crucis. These photographs are intended to show the gradual improvement in the definition of the extra lines, between κ Orionis and β Crucis, and to indicate their identity of origin throughout.

The extra lines in the spectrum of β Crucis are singled out by comparison with another helium star, viz., κ Argus, of Division I*b*, in which the extra lines do not appear. The lines are drawn out by themselves below the spectrum of β Crucis. They are then compared directly by juxtaposition with a drawing of the spectrum of oxygen as tabulated in the spectrum of air by Neovius (Stockholm, 1891, and Appendix E, 1894, of 'Watts's Index').

This comparison shows a close correspondence in the grouping of the extra lines with the spectrum of oxygen. The most remarkable correspondence is in the case of the large group on either side of Hδ. A slight shift of about a tenth metre is required to bring the groups into identical positions. However, the close similarity of the whole grouping of the two spectra as they appear on the plate admits of little doubt that the extra lines actually constitute the spectrum of oxygen. If this be established the spectrum of the first division of helium stars would be due to hydrogen, helium, and oxygen.

The scale attached to the spectra is based on standard lines that can be identified with certainty in the stellar spectra. It is interpolated between the standard lines. Its position in relation to the spectra is determined by the hydrogen lines. The wave-lengths employed are in accordance with Ångström's scale.

On the original negatives the distance between (H) and (F) measures about 1 inch. The negatives are enlarged about eight and a half times. It is difficult to fix the position of the lines—and especially of the hydrogen lines—on these enlargements with sufficient accuracy. A further correction than this would account for is however required in order to reduce the two spectra to exact coincidence. I believe it should be sought to some extent in a re-examination of the adopted wave-lengths of the hydrogen and of the oxygen spectra.

The spectrum of γ Argus is given on the plate in order to identify

it as a helium star. It contains two crucial lines of helium. The Wolf-Rayet stars, of which it is the principal example, are thus classified as helium stars. There are also some coincidences between the bright lines of γ Argus and the spectrum of oxygen, which suggest a possible connection.

The spectrum of μ Centauri is also given as a bright line helium star. The bright lines in this case are due to hydrogen, and the spectrum resembles that of γ Cassiopeiæ. The spectrum of δ Centauri is similar.

I take this opportunity of presenting a summary of the spectra of 116 stars to the $3\frac{1}{2}$ magnitude in the Southern Hemisphere. They were photographed between May and October last by means of my own object-glass prism, mounted in front of the Cape astrographic telescope. This instrument, which is similar to my own telescope at Rusthall, with which the spectra of the northern stars were photographed, was kindly placed at my disposal by H.M. Astronomer, Dr. Gill. It may be a little time before the actual photographs of the stellar spectra are ready for presentation, and meanwhile the results are of interest.

In my previous paper I divided the sphere into eight equal areas consisting or two galactic equatorial areas and two galactic polar areas, situated on either side of the galactic equator. The northern stars already given occupy the upper or northerly lateral areas A, B, C, and D, also the southerly area AA. The southern stars now given occupy the lower or southerly lateral areas BB, CC, and DD. Their photographic spectra are distributed into these areas, and are classified on the same system as in the previous paper. The table of distribution for the whole sphere by areas and classes is given below.

There are in all 89 helium stars (Division I), distributed 71 in the galactic zones and 18 in the galactic polar areas, the areas being equal. There are 29 in the upper galactic zone (B and BB), and 42 in the lower galactic zone (C and CC). There are 9 in the upper polar areas (A and AA), and 9 in the lower polar areas (D and DD). There are 23 in the northerly halves of the two galactic zones (B and C) and 48 in the southerly halves (BB and CC).

The 81 stars in Division II, the Sirian stars, and Division III, the Procyon stars (which along with Division I constitute Secchi's Type I) are rather irregularly distributed throughout the sphere. There are 40 in the galactic zones and 41 in the galactic polar areas. There are 18 in the upper galactic zone (B and BB) and 22 in the lower (C and CC). There are 29 in the upper polar areas (A and AA) and 12 in the lower (D and DD). To the extent of the observations there is no condensation of stars of Divisions II and III in the galactic zones as there is in the case of stars of Division I.

The 106 stars in Divisions IV and V (II and III of Secchi's types)

are fairly evenly distributed throughout the sphere. There are 52 in the galactic zones and 54 in the galactic polar areas. There are 22 in the upper galactic zone (B and BB) and 30 in the lower (C and CC). There are 27 in the upper polar areas (A and AA) and 27 in the lower (D and DD).

The general distribution of the types of spectra throughout the sphere to the extent of the observations bears out generally the conclusion that stars with spectra of the more advanced types, in order of development, are evenly distributed in space. Also that stars with spectra more recent in order of development are mostly congregated in the galactic zones. The helium stars of Division I are predominant in the Southern Hemisphere, being congregated in the lower or southerly halves of the galactic zones (BB and CC). They include 48 stars out of a total of 94 stars in those areas. They are also more closely congregated in the vicinity of the galaxy than is the case in the northerly halves of the galactic zones. In the contiguous constellations of Musca, Crux, Centaurus, Lupus, and Scorpio there are 27 helium stars out of a total of 36 stars included in the tables. (The distribution of the helium stars throughout the sphere was illustrated by two small hand charts, not reproduced, on which these stars are coloured red.) Apparently the region in which the first stage of stellar development is now most active lies in the southerly half of the galaxy.

Table I.

Photographic Stellar Spectra—Stars to Magnitude $3\frac{1}{2}$.

Summary of Southern Stars—Regions BB, CC, and DD.

	Mag.	Div.	Area.		Mag.	Div.	Area.
Aquila.				Argo.			
λ	3·3	I (*b*)	CC	λ	2·5	IV	BB
				μ	2·9	IV	BB
Ara.				ν	3·5	I (*b*)	CC
α	2·9	I (*b*)	CC	ξ	3·4	IV	BB
β	2·8	IV	CC	π	2·7	IV	CC
γ	3·6	I (*a*)	CC	ρ	3·2	III	BB
ζ	3·2	IV	CC	σ	3·5	IV	CC
				τ	3·2	IV	CC
Argo.				υ	3·4	III	CC
α	0·4	III	CC				
β	2·0	II	CC	Canis Major.			
γ	3·0	I (*b*)	CC	α	−1·4	II	CC
δ	2·2	II	CC	β	2·0	I (*a*)	CC
ϵ	2·1	IV	CC	δ	1·9	IV	CC
ζ	2·5	I (*b*)	CC	ϵ	1·5	I (*a*)	CC
θ	2·9	I (*a*)	CC	ζ	3·0	I (*b*)	CC
ι	2·5	III	CC	η	2·4	I (*b*)	CC
κ	2·7	I (*b*)	CC	o^2	3·0	I (*b*)	CC

Table I—*continued.*

	Mag.	Div.	Area.
Capricornus.			
β	3·4	IV	CC
Centaurus.			
α	0·7	IV	CC
β	1·2	I (*a*)	BB
γ	2·4	II	BB
δ	2·8	I (*b*)	BB
ϵ	2·6	I (*a*)	BB
ζ	2·7	I (*b*)	BB
η	2·5	I (*b*)	BB
θ	2·7	IV	BB
ι	3·0	III	BB
κ	3·3	I (*b*)	BB
λ	3·4	I (*b*)	CC
μ	3·4	I (*a*)	BB
Circinus.			
α	3·5	III	CC
Columba.			
α	2·7	I (*b*)	CC
β	2·9	IV	CC
Crux.			
α	1·3	I (*a*)	BB
β	1·7	I (*a*)	BB
γ	2·0	V	BB
δ	3·4	I (*b*)	BB
Doradus.			
α	3·1	I (*b*)	DD
Eridanus.			
α	1·0	I (*b*)	DD
θ	2·6	II	DD
ϕ	3·5	I (*b*)	DD
χ	3·9	IV	DD
Grus.			
α	1·9	I (*b*)	DD
β	2·2	V	DD
γ	3·0	I (*b*)	DD
ϵ	3·5	II	DD
Hydrus.			
α	2·9	III	DD
β	2·7	IV	DD
γ	3·2	V	DD
Indus.			
α	3·1	IV	DD
Lepus.			
α	2·7	III	CC
β	3·0	IV	CC
ϵ	3·3	IV	CC
μ	3·3	I (*b*)	CC
Libra.			
σ (20)	3·2	V	BB
Lupus.			
α	2·6	I (*a*)	BB
β	2·8	I (*a*)	BB
γ	3·2	I (*a*)	BB
δ	3·7	I (*a*)	BB
ϵ	3·7	I (*b*)	BB
Musca.			
α	2·9	I (*b*)	CC
β	3·4	I (*b*)	CC
Ophiuchus.			
β	2·9	IV	BB
ζ	2·8	I (*a*)	BB
η	2·6	II	BB
θ	3·4	I (*b*)	BB
κ	3·4	IV	BB
Pavo.			
α	2·1	I (*b*)	DD
β	3·3	III	DD
δ	3·5	IV	DD
Phœnix.			
α	2·4	IV	DD
β	3·3	IV	DD
γ	3·4	IV	DD
Piscis Austr.			
α	1·3	II	DD
Reticulum.			
α	3·3	IV	DD
Sagittarius.			
γ^2	3·0	IV	CC
δ	2·8	IV	CC
ϵ	2·1	I (*b*)	CC
ζ	2·9	II	CC
η	3·0	V	CC
λ	3·1	IV	CC
π	3·1	III	CC
σ	2·3	I (*b*)	CC
ϕ	3·3	I (*b*)	CC
Scorpio.			
α	1·1	V	BB
β'	2·9	I (*a*)	BB
δ	2·5	I (*a*)	BB
ϵ	2·2	IV	BB
θ	2·1	III	CC
ι'	3·3	III	CC
κ	2·6	I (*a*)	CC
λ	1·7	I (*a*)	CC

Table I—*continued.*

	Mag.	Div.	Area.		Mag.	Div.	Area.
Scorpio.				Telescopium.			
μ	3·6	I (*a*)	BB	α	3·5	I (*b*)	CC
π	3·1	I (*a*)	BB				
σ	3·0	I (*a*)	BB	Toucan.			
τ	2·9	I (*a*)	BB	α	2·8	IV	DD
v	2·8	I (*b*)	CC				
				Triangulum.			
Serpens.				α	2·2	IV	CC
η	3·4	IV	BB	β	3·1	III	CC
				γ	3·1	II	CC

NOTE.—The magnitudes are taken from the 'Nautical Almanac' (or from Gould).

Table II.

Summary Tables of Distribution of Gaseous Nebulæ and of Stellar Types. Stars to the $3\frac{1}{2}$ Magnitude.

Table No. 1.

Stellar Types.	A.	B.	C.	D.	Total.	AA.	BB.	CC.	DD.	Total.
Planetary nebulæ	2	3	8	2	(15)	2	7	3	0	(12)
Extended nebulæ......	1	4	8	4	(17)	1	4	3	1	(9)
Total gaseous nebulæ ..	3	7	16	6	(32)	3	11	6	1	(21)

NOTE.—Extracted from Table in Frost's edition of 'Scheiner's Astronomical Spectroscopy.'

Table No. 2.

Stellar Types.	A.	B.	C.	D.	Total.	AA.	BB.	CC.	DD.	Total.
Division I	3	6	17	3	(29)	6	23	25	6	(60)
„ II	10	7	0	3	(20)	3	2	5	3	(13)
„ III	7	8	8	4	(27)	9	1	9	2	(21)
„ IV	14	8	9	13	(44)	9	9	16	9	(43)
„ V	1	2	4	3	(10)	3	3	1	2	(9)
	35	31	38	26	(130)	30	38	56	22	(146)

PHOTOGRAPHIC STELLAR SPEC

Comparison of Oxygen with the Extra Lines in the Spectra of the Helium Stars

Type 1, Div. 1a. 1

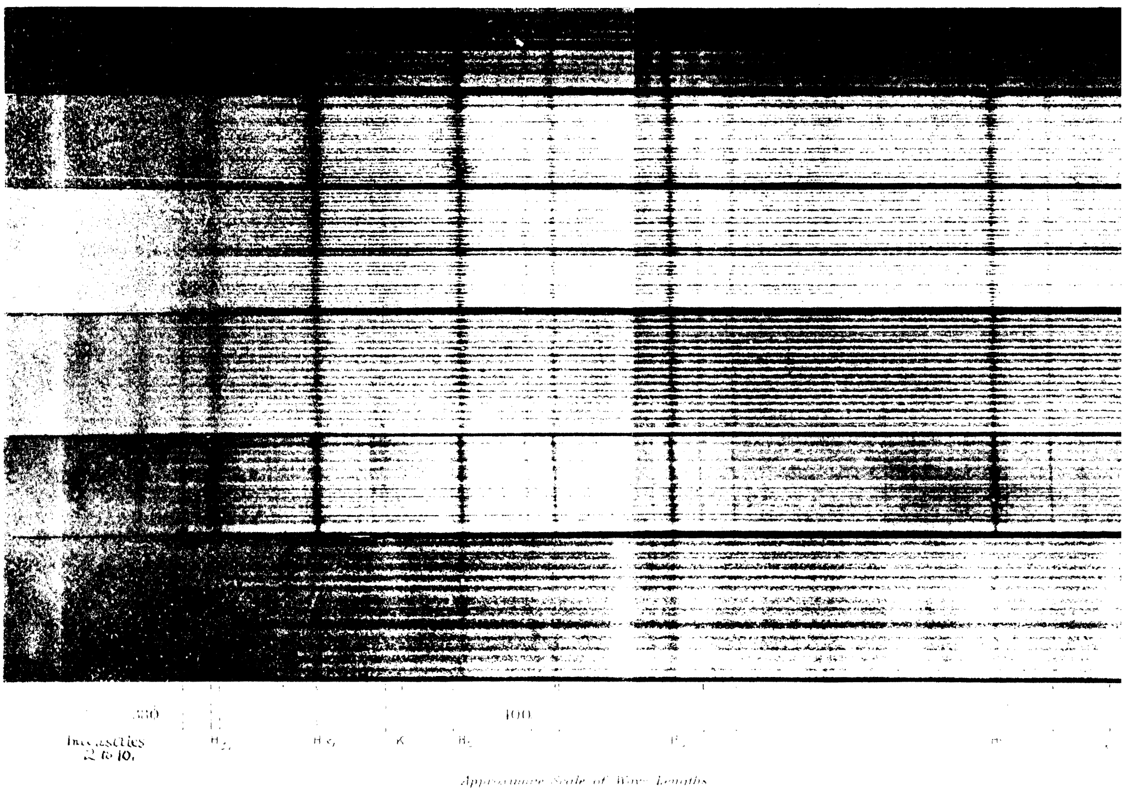
2

3

4

5

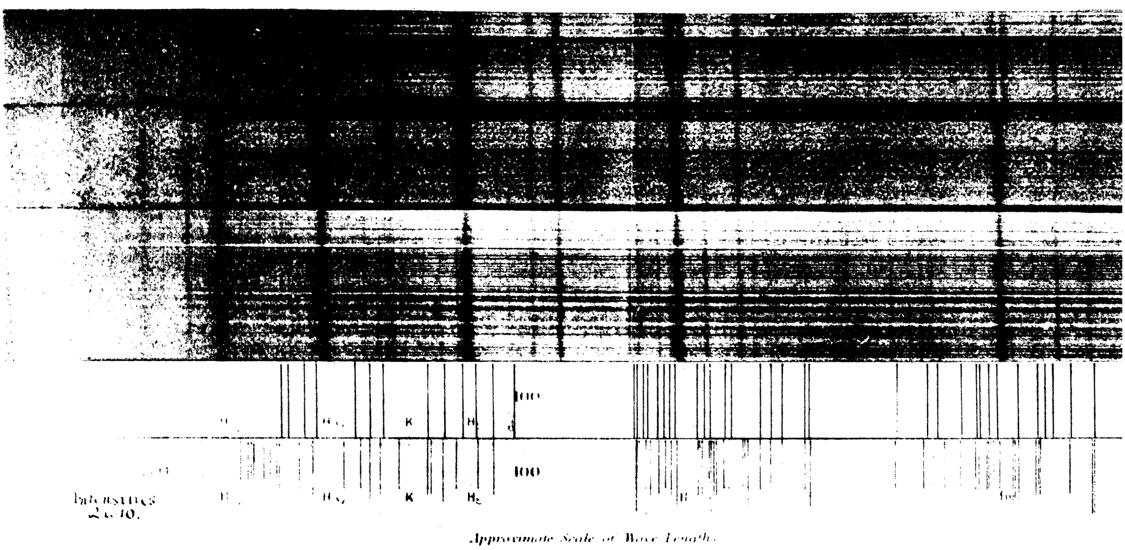
Type 1, Div. 1b. 6



Type 1, Div. 1b. 7

8

Type 1, Div. 1a. 9



PECTRA.

ım Stars, β Crucis, &c. (Div. Ia).

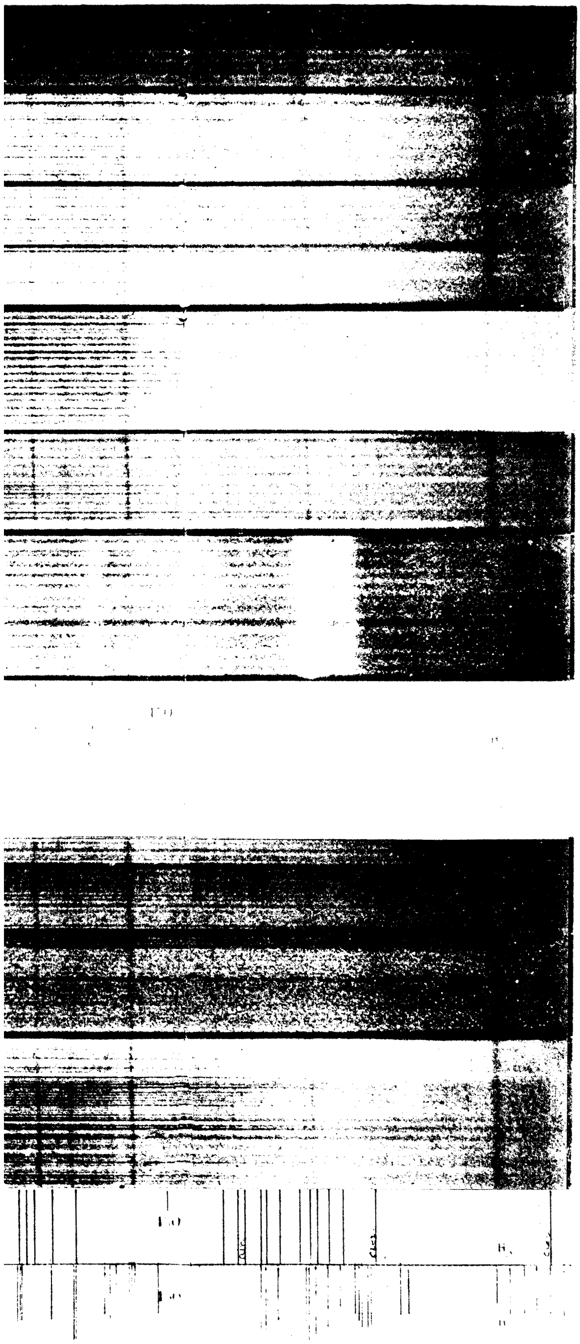


Table No. 3.

Stellar Types.	A.	B.	C.	D.	Total.	AA.	BB.	CC.	DD.	Total.
Division I	3	6	17	3	(29)	6	23	25		(60)
„ II and III	17	15	8	7	(47)	12	3	14	5	(34)
„ IV and V	15	10	13	16	(54)	12	12	17	11	(52)
	35	31	38	26	(130)	30	38	56	22	(146)

Table No. 4.

Stellar Types.	A and AA.	B and BB.	C and CC.	D and DD.	Total.
Division I	9	29	42	9	(89)
„ II and III	29	18	22	12	(81)
„ IV and V......	27	22	30	27	(106)
	65	69	94	48	(276)

February 24, 1898.

Sir JOHN EVANS, K.C.B., D.C.L., LL.D., Treasurer, in the Chair.

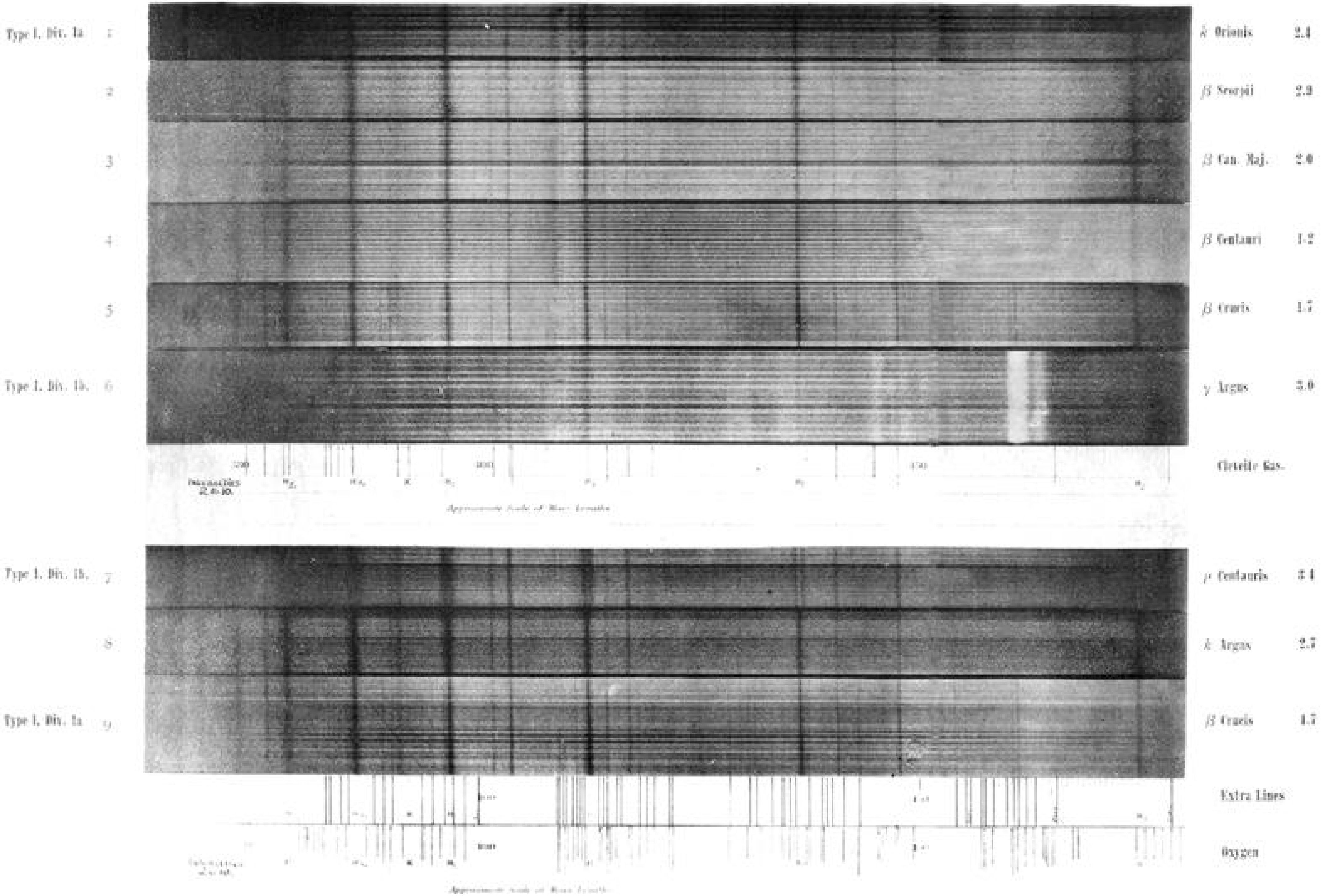
Meeting for Discussion.

Subject :—The Scientific Advantages of an Antarctic Expedition.

The Discussion was opened with a communication by Dr. John Murray, and the following gentlemen contributed remarks :—The Duke of Argyll, Sir J. D. Hooker, Dr. Nansen, Dr. G. Neumayer of Hamburg, Sir Clements Markham, Dr. A. Buchan, Sir A. Geikie, Dr. Sclater, Professor D'Arcy Thompson, Admiral Sir W. J. L. Wharton.

PHOTOGRAPHIC STELLAR SPECTRA.

Comparison of Oxygen with the Extra Lines in the Spectra of the Helium Stars, β Crucis, &c. (Div. Ia).



PHOTOGRAPHIC STELLAR SPECT

Comparison of Oxygen with the Extra Lines in the Spectra of the Helium Stars,

Type I, Div. 1a. 1

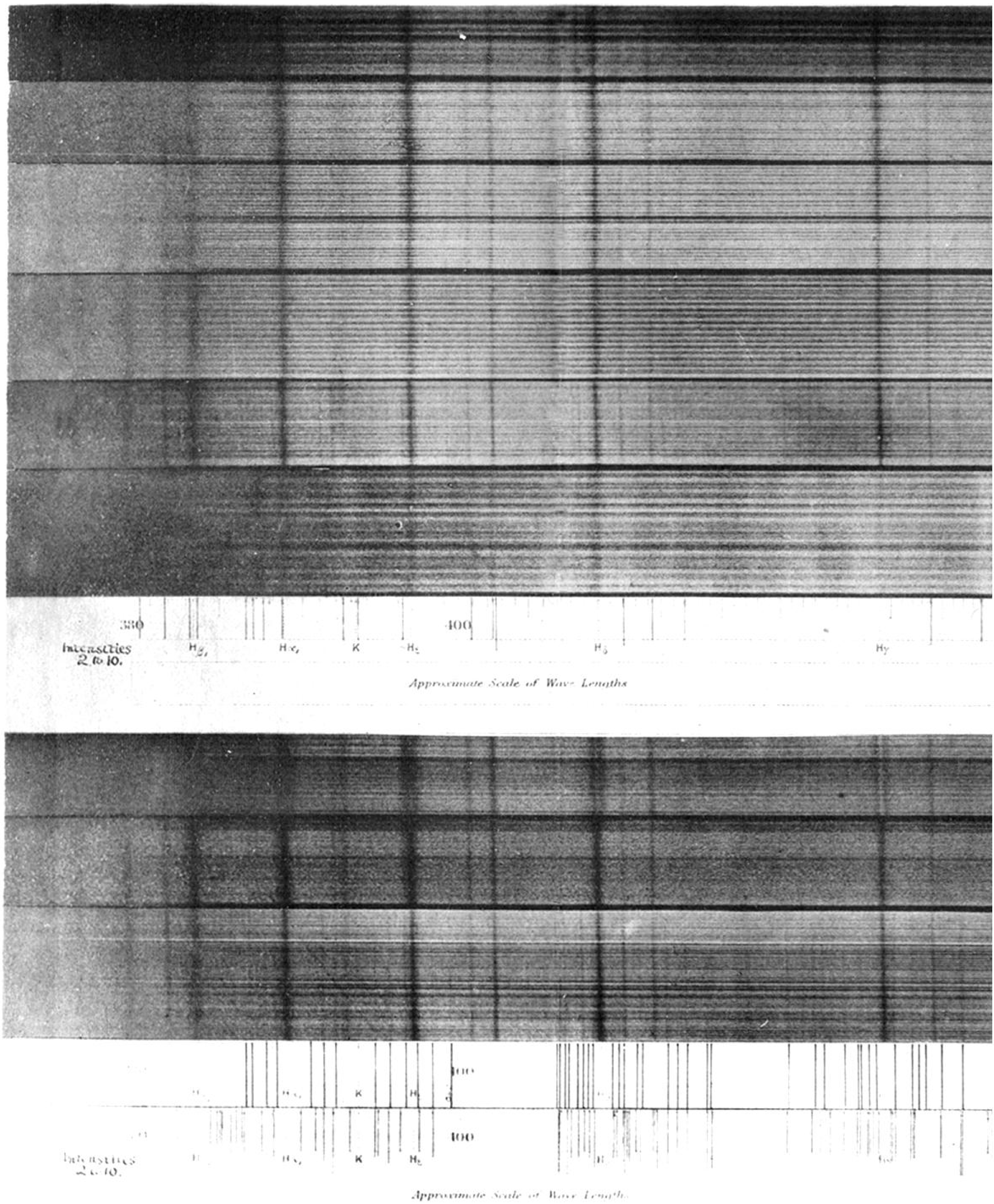
2

3

4

5

Type I, Div. 1b. 6



Type I, Div. 1b. 7

8

Type I, Div. 1a. 9

PECTRA.

um Stars, β Crucis, &c. (Div. I*a*).